CLAIMS

1. Apparatus for determining the disposition of an object relative to a reference frame, comprising:

at least one field generator, which generates an electromagnetic field in a vicinity of the object;

at least one transducer, which is fixed to the object and which vibrates at a predetermined vibrational frequency and emits energy, responsive to an interaction of the electromagnetic field therewith;

one or more detectors in a vicinity of the object which detect the energy emitted by the transducer and generate signals in response thereto; and

a signal processor which receives and processes the detector signals to determine coordinates of the object.

2. Apparatus according to claim 1, wherein there is substantially no wired connection to the transducer.

3. Apparatus according to claim 1, wherein the signal processor processes the detector signals to determine a time of flight of acoustic energy indicative of a distance of the transducer from at least one known point in the reference frame.

4. Apparatus according to claim 3, wherein the at least one transducer comprises two or more transducers, which vibrate at substantially different respective frequencies, and wherein the signal processor processes the detector signals responsive to the different frequencies.

5. Apparatus according to claim 4, wherein the signal processor determines the distance from the at least one fixed point to the two or more transducers in order to determine an angular orientation of the object.

6. Apparatus according to claim 1, and comprising one or more ultrasound generators which emit ultrasound at frequencies substantially similar to the

frequency of the transducer, in order to cause the transducer to vibrate.

7. Apparatus according to claim 1, wherein the one or more detectors detect a modulation of the electromagnetic field responsive to vibration of the transducer.

8. Apparatus according to claim 1, wherein the at least one field generator comprises one or more radio frequency (RF) field generators, and wherein the one or more transducers vibrate and emit ultrasound radiation responsive to the RF field.

9. Apparatus according to claim 8, wherein the one or more detectors comprise a plurality of ultrasound detectors, situated at known locations in the reference frame, which receive the ultrasound radiation emitted by the one or more transducers.

10. Apparatus according to claim 8, wherein the one or more transducers comprise a plurality of transducers having different, respective frequencies, and wherein RF field generators generate fields at different, respective frequencies, corresponding to the different frequencies of the transducers.

11. Apparatus according to claim 10, wherein the at least one transducer comprises two or more transducers which are oriented relative to the object at substantially different respective angular orientations, and wherein the signal processor determines angular orientation coordinates of the object responsive to a difference in the energy emitted by the two or more transducers.

12. Apparatus according to claim 1, wherein the object comprises an invasive medical instrument, and wherein the signal processor determines coordinates of the instrument inside the body of a subject.

13. Apparatus according to claim 12, wherein the medical instrument comprises a probe having a physiological sensor fixed to a distal portion thereof, in proximity to the at least one transducer.

14. Apparatus for determining the disposition of an object relative to a reference

frame, comprising:

at least one field generator, which generates an electromagnetic field in a vicinity of the object;

a transducer, fixed to the object, which emits acoustic energy responsive to the electromagnetic field;

one or more detectors at known positions in a vicinity of the object, which detect the acoustic energy emitted by the transducer and generate signals in response thereto; and

a signal processor which receives and processes the detector signals to determine coordinates of the object.

15. Apparatus according to claim 14, wherein the transducer emits the acoustic energy substantially irrespective of any acoustic irradiation of the object.

16. Apparatus according to claim 14, wherein there is substantially no wired connection to the transducer.

17. Apparatus according to claim 14, wherein the signal processor determines a time of flight of the acoustic energy from the transducer to the one or more detectors.

18. Apparatus according to claim 17, wherein the time of flight comprises a time interval between an initiation of the electromagnetic field by the at least one field generator to an initial detection of the acoustic energy by the one or more detectors.

19. A method for determining the disposition of an object relative to a reference frame, comprising:

fixing to the object a transducer, which vibrates at a vibrational frequency thereof;

generating an electromagnetic field in a vicinity of the object;

detecting energy, emitted by the transducer responsive to an interaction of

the field with the transducer, the energy having a frequency dependent on the vibrational frequency of the transducer, at one or more locations in the reference frame and generating signals responsive thereto; and

processing the signals to determine coordinates of the object.

20. A method according to claim 19, wherein processing the signals comprises determining a time of flight of acoustic energy indicative of a distance of the transducer to at least one known point in the reference frame.

21. A method according to claim 20, wherein fixing a transducer to the object comprises fixing at least two transducers to the object, which vibrate at substantially different resonant frequencies.

22. A method according to claim 21, wherein processing the signals comprises determining a distance from the at least one fixed point to each of the at least two transducers in order to determine an angular orientation of the object.

23. A method according to claim 20, and comprising generating one or more ultrasound fields, at frequencies substantially similar to the resonant frequency of the transducer, in order to cause the transducer to vibrate.

24. A method according to claim 20, wherein detecting the energy comprises detecting a modulation of the electromagnetic field responsive to vibration of the transducer.

25. A method according to claim 20, wherein generating an electromagnetic field comprises generating a radio frequency (RF) field, and wherein detecting the energy comprises detecting acoustic radiation emitted by the transducer responsive to the RF field.

26. A method according to claim 25, wherein processing the signals comprises determining, for a plurality of known locations in the reference frame, a time of flight to each of the locations of the ultrasound radiation emitted by the transducer.

27. A method according to claim 26, wherein fixing a transducer to the object comprises fixing two or more transducers to the object at substantially different respective angular orientations, each of which vibrates at a substantially different respective resonant frequency, and

wherein generating an RF field comprises generating a field comprising frequency components corresponding to the respective resonant frequencies of the two or more transducers, and

wherein processing the signals comprises comparing signals generated responsive to the acoustic radiation detected at the different frequencies to determine an angular orientation of the object.

28. A method according to claim 19, wherein determining the disposition of an object comprises determining the disposition of an invasive medical instrument.

29. A method according to claim 28, wherein determining the disposition of the invasive medical instrument comprises determining the disposition of an invasive medical instrument with a physiological sensor fixed to a distal portion thereof, in proximity to the transducer.